NOVEL LIQUID BLENDS FOR POLYETHYLENE STABILIZATION
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CONTENT

• Key considerations in phosphite selection for PE stabilization

• CTQ’s for PE stabilization: Customer requirements

• WESTON® 705, the next generation phosphite

• WESTON® LPP (Liquid Productivity Platform) antioxidants, the next generation stabilizer system for PE film

• Summary
KEY CONSIDERATIONS IN PHOSPHITE SELECTION FOR PE STABILIZATION
The additive system must protect the polymer through the entire application life cycle
Phosphites are the most effective class of secondary antioxidants
FACTORS AFFECTING PHOSPHITE PERFORMANCE

- % P
- Chemical structure
  - Tris Hindered Aryl
  - Tris Alkyl
  - Mixed Alkyl Hindered Aryl
- Stabilizer hydrolytic stability
- Inherent thermal stability
- Melting point
- Formulation/loading level
  - Stabilizer solubility
- Resin type

All factors need to be considered
FACTORS AFFECTING PHOSPHITE PERFORMANCE

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• Resin type
Hydrolytic stability of WESTON® 705 phosphite is better than TNPP
In-Polymer Hydrolysis at 50C@ 80%RH
Tri-Alkyl-phosphite vs. Tri-Aryl-phosphite

Weston® 705 phosphite exhibits superior hydrolytic stability to tri-alkylphosphite
FACTORS AFFECTING PHOSPHITE PERFORMANCE

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How to handle WESTON® 705 phosphite in the plant?

Current TNPP handling equipment easily handles WESTON® 705 phosphite.
FACTORS AFFECTING PHOSPHITE PERFORMANCE

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IMPACT OF LOW ADDITIVES SOLUBILITY ON POLYMER PROPERTIES

Plate-out of insoluble solid additives can result in build-up during process operations

- Potential for contamination
- Regular manufacturing interruption - cleaning
- Negative impact on economics (downtime)
- Quality issues (gel formation on start up)

Blooming or migration of insoluble additive alters surface properties

- Poor aesthetics form visible powder deposits
- Reduced gloss
- Reduced printability
- Change adhesion properties

Need to consider ancillary impact of additives
CTQ’S FOR PE STABILIZATION: CUSTOMER REQUIREMENTS
CUSTOMER’S CTQ’S FOR POLYETHYLENE STABILIZATION:

• Best in-polymer cost/value performance
  – Standard applications – cost/performance balance
  – Demanding applications – performance through the life cycle

• Reliable global supply network
  – Security of supply to ensure 100% plant utilization
  – Optimized supply chain efficiency & costs

• Consistent quality
  – Globally supply same grade same quality
  – Ability to measure loading levels (in-polymer analysis, easy/practical methods)

• Innovation partner / solution provider
  – Needs of industry & consumers are constantly changing

• Compliance with increasing regulatory framework
  – Comprehensive testing to meet stringent regulations compared to those grandfathered
  – FDA, EFSA, Japanese MITI, Chinese, Canadian, ANVISA, etc…
  – REACH
WESTON® 705
THE NEXT GENERATION PHOSPHITE
Liquid Phosphites: Availability for Polymer Protection

Superior performance and benefit throughout PE film value chain
Liquid Phosphites: Availability for Polymer Protection

Superior performance and benefit throughout PE film value chain
WESTON® 705 PHOSPHITE GLOBAL SUPPLY TODAY AND TOMORROW

Existing Liquid Phosphite Production

Planned Liquid Phosphite Production

Morgantown, WV

Altamira, Mexico

Latina IT

Saudi Arabia

SE Asia
KEY CHARACTERISTICS OF WESTON®705 PHOSPHITE PROCESS & QUALITY

- Scale-up and commercialization
  - WESTON®705 is produced on commercial scale
- Safety and environment
  - Responsible Care (RC) 14001 certified
  - Best in class in minimized emissions
- Process capability
  - State-of-the-art PCl3 handling
  - ISO-9001 certified
  - Best in class first pass yield
  - QC methods: Six sigma methodology
FULL PHOSPHITE MASS-BALANCE: PHOSPHITE/PHOSPHATE/HYDROLYSIS PRODUCTS

Schematic (simplified) Polyethylene Polymerization Process
WESTON® 705 PHOSPHITE - DEVELOPMENT

Replace TNPP & Alkanox® 240 types
   Global supply network (US, Europe, Saudi Arabia, Korea)
   Worldwide regulatory approvals in progress

WESTON® 705 platform:
   Product variations in Addvant™ development pipeline
   Expansive range with different properties and activities
   Synergistic blends (e.g. phosphite + phenolic)
   Liquids, solids, NDB® - for seamless change and efficiency
   Phenolics too

WESTON® 705 platform extension
   New chemistries for next RETEC

WESTON® 705 – Full innovation platform
WESTON® 705 phosphite regulatory approval status

- Completed Registration:
  - USA (TSCA)
  - Australia (AICS)
  - Korea (ECL)
  - Philippines (PICCS)
  - New Zealand (NZIoC)
  - Taiwan
  - EU (EINECS), REACH
- EFSA approval obtained (SML = 5 mg/kg, all polymers)
- FDA compliance in progress
- Registration in Canada, China & Japan expected in 2012
WESTON® LPP (LIQUID PRODUCTIVITY PLATFORM) ANTIOXIDANTS

THE NEXT GENERATION STABILIZER SYSTEM
WESTON® LPP ANTIOXIDANT PRODUCTS

• WESTON® 802 stabilizer blend
• WESTON® 812 stabilizer blend
• WESTON® 815 stabilizer blend

Consider the benefits of novel liquid blends
WESTON® LPP stabilizer viscosity temperature profile

Novel liquid blends even easier to handle in the plant
MFI comparison: multipass extrusion

WESTON® 705 liquid blends provide superior polymer protection
Gas-Fading: WESTON® LPP Stabilizer Performance

WESTON® LPP stabilizer outperforms solid ALKANOX® 240 phosphite
SUMMARY AND RECOMMENDATIONS (1)

• Addivant™ is committed to innovation:
  – Delivering attractive, in-polymer stabilization costs
  – Meeting performance requirements for demanding, high value applications

• Addivant™ is investing in high growth regions and its global manufacturing footprint

Addivant™ strategy – to be the world’s leading phosphite supplier
SUMMARY AND RECOMMENDATIONS (2)

• Addivant™ is the global leader for liquid antioxidants

• Liquid blends of phenolic / phosphites are cost effective

• WESTON® 705 stabilizer platform will deliver:
  – Lower in-polymer cost
  – Complete platform encompassing phosphites, phenolics, & synergistic blends
  – Full physical form range

Addivant™ strategy – to be the world’s leading phosphite supplier
YOUR BENEFITS WHEN WORKING WITH ADDIVANT™

• The widest range of specialty stabilizers
• True innovation and partnership in development
• Local service, worldwide, including strategic investments in emerging markets
• Technical expertise and applications knowledge that adds value
• Regulatory compliance and corporate responsibility
• A commitment to future growth
YOUR BENEFITS WHEN USING ADDIVANT™ STABILIZERS

**Processing Efficiency**
- Protecting polymer architecture and preventing discoloration using antioxidants

**Durability & Protection**
- Maintaining the color & appeal of plastic products.
- Extending product

**Production Efficiency**
- Safer addition of additives and improved productivity using different product forms

**Compliance in Use**
- Global regulatory, environmental & food contact compliance
Why use this technology?

Plastics and elastomers generally age rapidly under the effects of heat, shear stress and mechanical loading in an oxygen environment. Antioxidants are used to combat this degradation. They extend the product’s life and its appearance, protecting against:

- Degradation during processing,
- Discoloration, and
- Heat aging, maintaining strength, stiffness or flexibility.

Where can it go?

Antioxidants are used to protect a broad range of plastics from mechanical and optical property degradation. They interrupt the degradation process in different ways, according to their structure.

The following pages contain examples of several applications where Chemtura antioxidants are widely used, the type of stabilization required and the benefits they bring for each application.

Click on the images below to find out more about these popular applications and how antioxidant technology helps achieve processing efficiency, extended life and appearance:

Polyolefins